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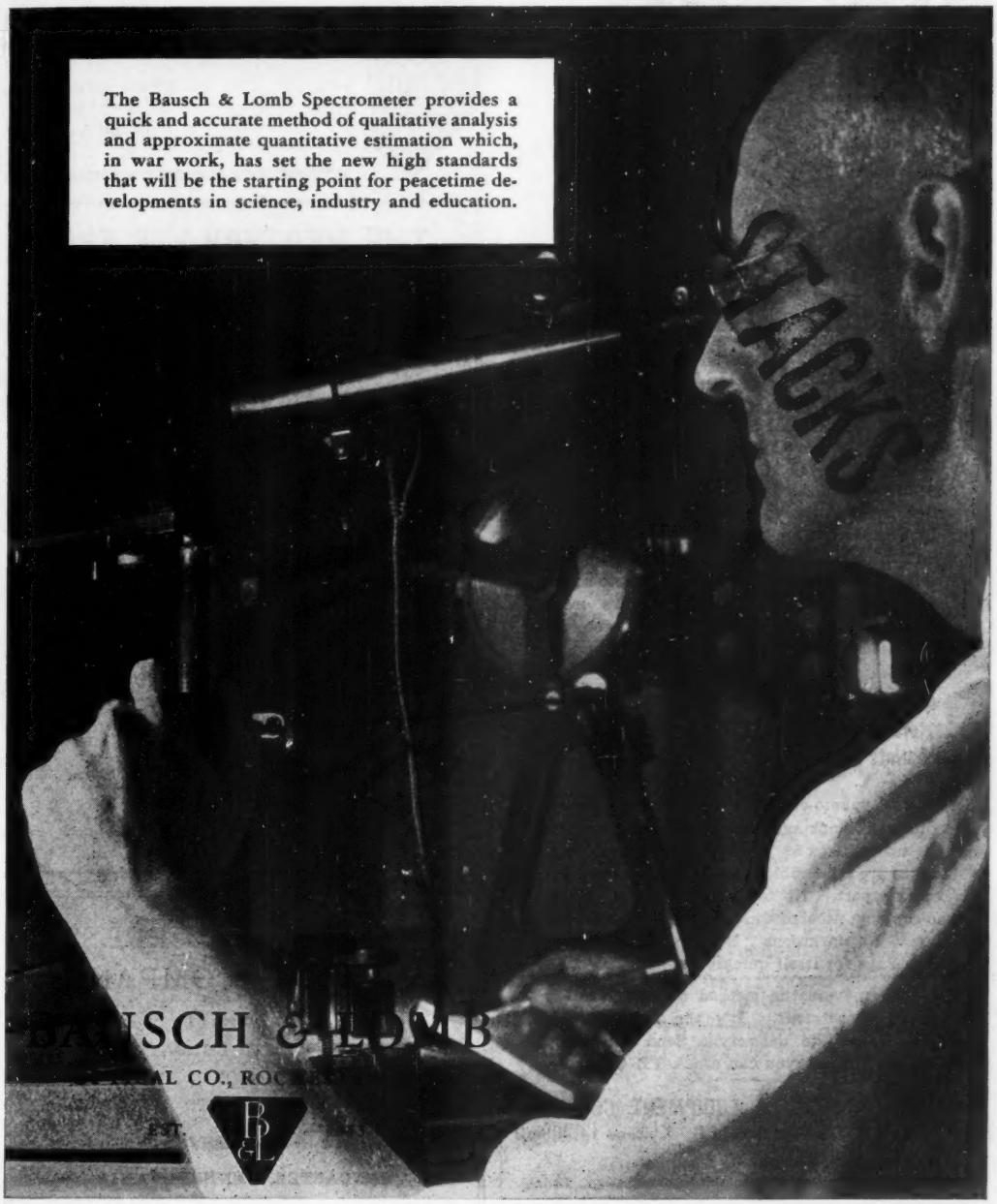
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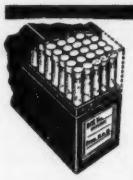

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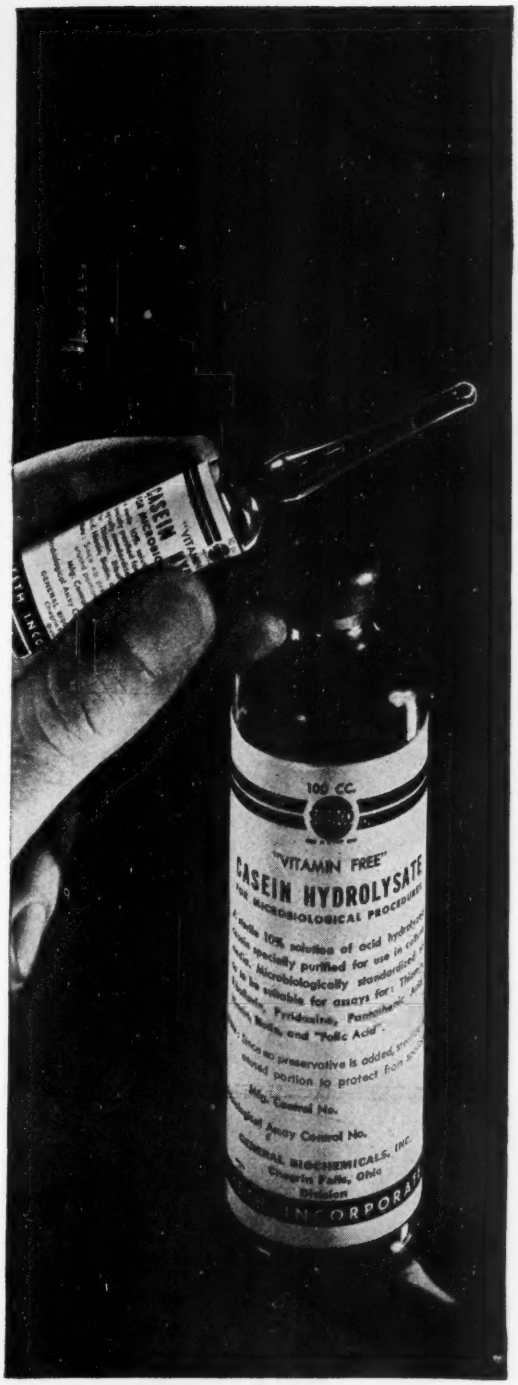

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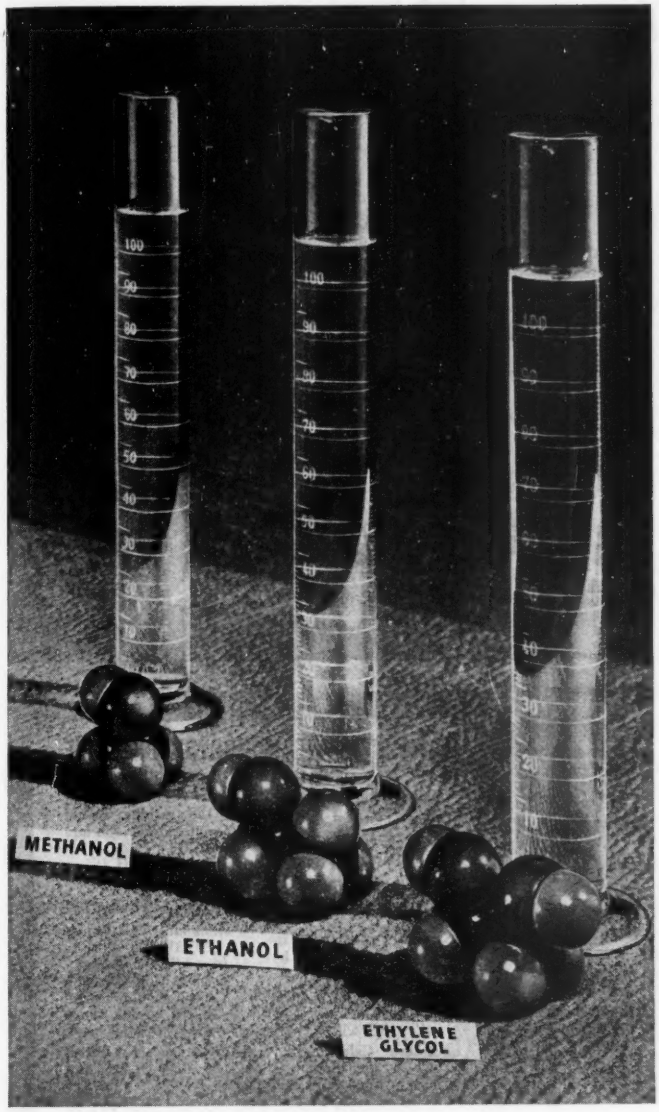

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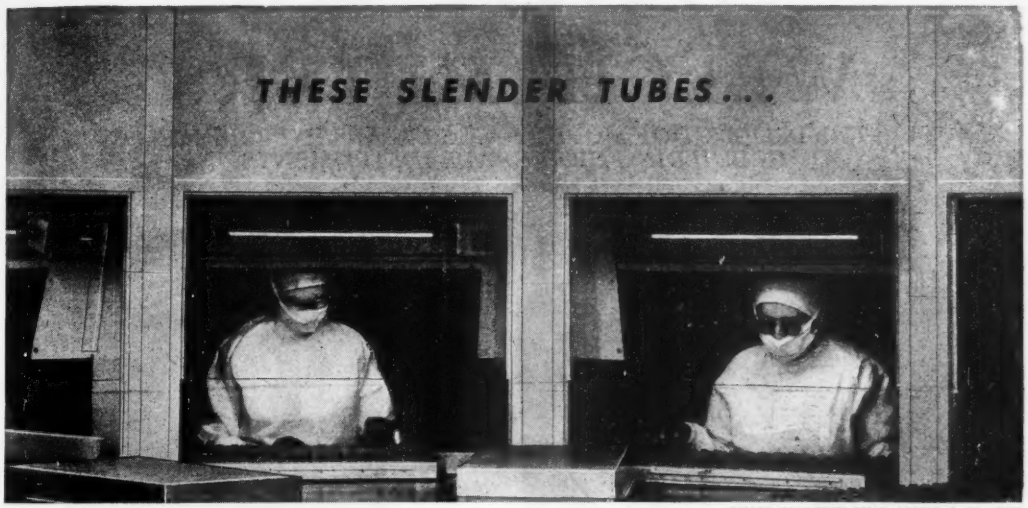

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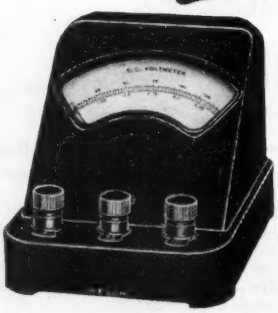

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THE SCIENCE OF BIOLOGY AND THE FUTURE OF MAN[1]

By Professor ANTON J. CARLSON

UNIVERSITY OF CHICAGO

THE title for my discussion is too formidable for me, and, I believe, for every other biologist, that is, if we propose to stick strictly to the known and the probable. However, I think the fundamental issue before us is the significance and the service of the science of biology in man's future biologic, social and economic development. And that raises another fundamental question. I think we are all agreed on this point: that understanding should be a significant factor for to-morrow's man, both for him as an individual and for him as an effective factor in the social environment. The only question is—to what degree is it possible to bring this about? That is primarily a question of development of control by the higher centers of our nervous system, that is, the cerebrum, over the primitive lower center of the brain, the hypo-thalamus. For biology of sub-human species and the history of man to date show that human actions have been determined more by the emotions, and the hypo-thalamus than by understanding, and reason based thereon.

I think at this point we biologists should be more than ready to confess that our science, to-day and more so to-morrow, depends on our sister sciences, chemistry and physics. We advance or fall together. It is perfectly true that the old style descriptive biology, classification of species, etc., can be accomplished with little or no background or understanding of either chemistry or physics; but functional biology, dynamic biology, as it has developed in the last 50 years and as it will further develop to-morrow, is very intimately dependent on parallel developments in the physical sciences. It is functional biology which constitutes and determines the behavior of man. This is the more difficult phase of biology. This is the

[1] Abstract of an address given before the National Association of Biology Teachers on September 16, at the Cleveland meeting of the American Association for the Advancement of Science.

field of biology filled with most of the unknowns, the gaps and the guesses. But we, the teachers in this field, must obviously master the known and somehow present it to our students, children and adults, in such a way, if possible, that the understanding of the human machinery in health and in disease becomes a dynamic factor in human behavior. What I have said so far seems, to me at least, obvious. That we have not achieved this goal up to the present most of you will agree. When it comes to the question of how we can more rapidly approach this goal, there will probably not be an equal unanimity of views and opinions among us.

In a recent national survey of the teaching of biology in the nation's high schools, under the direction of Dr. Oscar Riddle of the Carnegie Institution, the conclusion was reached that a deplorable percentage of the teachers of biology in our high schools were poorly equipped to perform this function in a manner demanded by the needs of man. There are probably not enough of superior teachers to go around either in biology or in any other field of education, knowledge and training. As an excuse for this condition is frequently offered the fact of the over-all low salaries of high-school instructors attracting too few superior men and women into that field. This may be so, but I seriously doubt that those men and women who understand the necessity for and the fundamental role of teaching, those people who would rather do or try to do this kind of service than any other thing, that these people are deflected from such course by a difference in remuneration of a few hundred or a few thousand dollars a year. It is, of course, true that the social status or prestige of any man or woman in our society is, unfortunately, determined so largely by the yard-stick of salary and material wealth. Where this view prevails the high-school teacher becomes an insignificant member of society, indeed. But the conviction that we are performing an essential and significant task should outweigh all other considerations, and ultimately society will recognize our important work.

There can be little doubt that for the fullest realization of the significance of biology for the future of man there must be much more serious consideration given in the high-school curriculum to human biology than is the case at present. And that means that much more fundamental attention must be given to the essentials of human biology in the training of the teachers for high-school positions in this field throughout the land. In a recent study of the impact of all the natural sciences on the college freshman in 16 central states, including Ohio, I found according to the measures used that psychology and chemistry came first, zoology—third and human biology—last or eighth. This relation probably reflects the situation in the high school if not as to time in the curriculum, at least as to the scientific quality of the teaching. I think you will agree that by tradition and regulations, there is a disproportion in the amount of attention given to the "ten thousand more or less useful facts" as against the efforts towards understanding of the fundamentals that may guide man's judgment and actions as to food, health and behavior towards his fellow man.

Before entering on my last topic, I should like to make these two points, as it were, in passing: (1) The teacher of biology in our high school should gain some courage, confidence and ambition from the well-known fact that for two thirds of his pupils the high-school teaching of human biology is all the formal aid to the understanding of human biology that these boys and girls will ever receive. And even those high-school graduates who later enter college may go through the entire liberal arts college course without further exposition to the important fundamentals of human biology in health and disease; (2) the above point which I think nobody can question raises a further problem, namely, that of the urgent need in our country of adult education in the fundamentals of human biology. It is, of course, a fact that education is never completed. New developments in human biology, health and disease go on at an accelerating pace in our times. Many adult fellow citizens never entered or completed even their high-school education. Most of the adult education in human biology now prevailing in our land is through advertising of foods, drinks, vitamins and other remedies by concerns primarily interested in greater sale of these products. Such advertising in the press and over the radio too frequently assumes the form of skilful weaving together of facts and fancies to be artistic lying. Should we not consider the possibility of making every high school in our land the center for well-conceived and well-directed evening courses for adults in fundamental human biology? Such courses could be directed, and I believe would be directed, by our best teachers, even without additional pay. Visual aids to such adult education such as slides, motion pictures, suitable reading materials are available. We should not be discouraged by small registration to begin with, because serious educational efforts are in competition with entertainment in motion pictures and radio and at the start come out second best.

Human biology can no longer be taught effectively solely by aid of the materials in the formalin jar supplemented by the best of books. Such effective teaching requires the aid of experiments, and demonstrations on living tissues, living organs, and living animals under anesthesia. In some States that type of teaching is prohibited or limited by law, in other cases it is limited or prevented by custom or social

pressure. Some people do not yet admit that man is an animal. How are we to remove this handicap, except through more effective adult education in human biology?

So far I have said little about biology in its bearing on the future of man. This phase of my talk will be largely a series of questions:

I. All the present evidence indicates that the human beings now inhabiting the earth are one species, irrespective of their color and form. But this knowledge has not yet succeeded in eliminating the ancient and ever-recurring superstition or belief in this or that "superior race." We admit superior individuals and, for varying times, superior families, but I know of no clear evidence of superior groups within the same species, given the same environment, food and educational opportunities. In many species below man it has been possible to breed, for specific forms, qualities and performance. Even if this was desirable for to-morrow in the case of man, it certainly has not been tried on a scientific basis up to date. So that, apart from the possibility of weakening our race to-morrow by the survival of too many of the inferior or less fit individuals, it is a futile pastime to tarry long with the question as to what extent the growing knowledge and possible control of heredity will benefit our race in the future.

II. Can application of relative justice in national and international relations ever avert the (to me) insane destruction of the best in human lives and the valuable products of human toil which prevail in war? I am well aware that even some men and women who think (including some biologists) have held the view that war aids and improves the human race. There are others who take the opposite view. All we can say is, we have no controls. And that raises the question, assuming we biologists were permitted to teach: What can we teach on this issue?

III. Nearly every activity of man (social, political, industrial) has an impact on and frequently a limiting factor in the dynamic biology of man. Thus:

(a) In many industries we are face to face either with new chemicals injurious to man or with dangerous concentrations of injurious chemicals. I have said earlier and I repeat here that in our so-called civilized countries, through industry and science, man is being exposed to new chemical environments by virtually turning the earth inside out at the rate to which man and other species in the past were seldom, if ever, exposed. The chemical poisons of our industrial civilization—what will they do over the centuries to our air, our soil, our waters and our human frame? Will biologic understanding and increasing medical knowledge cope with this problem to-morrow?

(b) Urbanization and industrialization pose problems of housing and food, work and leisure, not present under the more primitive conditions which governed the greater span of man's evolution. This means that these phases of life become part of human biology to-morrow. Why not start studying them to-day?

(c) Man of the stone age appears to have gained fair control over most of the larger predatory species competing with him for the control of the earth and a place in the sun. But the stone hammer and the flint spear head were poor weapons against the harmful and disease-bearing insects, and perfectly impotent against the myriads of man's microscopic and sub-microscopic enemies. Modern biology, to-day's preventative and corrective medicine, have gained some control over these injurious and deadly hordes. That may spell better health, better mental and physical efficiency and more years of useful life for the man of to-morrow. But we can not be sure of these results because new and injurious factors may sneak in, as it were, through the back door of our civilization. One of these factors may be greater malnutrition, as all species, man included, tend to multiply beyond the limits of available foods for an optimum diet. When the check on over-population by disease is checked by medical science, can and will the man of to-morrow substitute understanding as a check on population increases beyond the conditions for optimum living? Or will he resort to war?

(d) The harder conditions of life in man's past and the virtual absence of scientific control of disease until yesterday unquestionably resulted in the earlier elimination of the weaker and the less fit members of our race. How is that important function for the race to be taken care of by and for the man of to-morrow? We can not answer this question now, for the simple reason that we do not know how soon and to what degree man's action will be governed by understanding and the long view, rather than by the emotions of to-day and the taboos of yesterday.

(e) Assuming increasing control of infectious diseases and a decrease in the prevalence of war and a not too rapid weakening of the human race by the reproduction and survival of the less fit, it seems clear that food will some day be the limiting factor of our numbers, if not of our health and efficiency, no matter how much more understanding we may gain of the interior of the earth, of sub-atomic energy and of the super galaxies in the distant heavens. That means that agriculture and foods are clearly must items in the teaching of human biology to-morrow. But why wait till to-morrow?

THE IMPORTANCE OF PLANTS[1]

By WILLIAM J. ROBBINS

PROFESSOR OF BOTANY, COLUMBIA UNIVERSITY, AND DIRECTOR OF THE NEW YORK BOTANICAL GARDEN

NOTHING I have to say here is new; all of it has been known for many years, some of it for a century or more. Yet I believe that the repetition from time to time of facts of fundamental import has its place. Even scientists can on occasion review with profit the broad significance of the material on which they spend their lives. One group of facts of the character I mention concerns the place occupied by plants in the life of man and the economy of nature.

PLANTS THE BASIS OF LIFE

Plants are the basis upon which all other life depends. In the last analysis they supply us with all the food we eat, they maintain the oxygen content of the air and they are the primary source of those important accessory foods, the vitamins. Without plants we would starve to death, die of suffocation and expire from a combination of deficiency diseases. In addition, plants are the chief means by which the energy of the sun is and has been in ages past caught and stored for us in usable form. Without plants fire would be unknown because there would be no wood or coal or petroleum to burn, and electricity—except as a natural phenomenon—would be at most limited to areas freely supplied with water power.

The essential relation of plants to the food we eat, the air we breathe and the energy we dissipate with such reckless abandon is based on two of their characteristics. These are their ability to store the energy of the sun's rays in sugar, starch, cellulose, oils, fats and other constituents of the plant body, and their ability to construct from simple and elementary substances types of chemical compounds necessary for the existence of animals, including ourselves.

The first of these powers, limited from a practical standpoint to plants which possess the green pigment chlorophyll, is the familiar process of photosynthesis in which the plant transforms water obtained from the soil and gaseous carbon dioxide from the air into sugar and oxygen. In the course of photosynthesis, which occurs only in the light, energy from the sun is stored in the product sugar and in the starch, wood, oils and fats or other organic substances constructed by living things from this sugar. The energy we obtain by burning coal, lignite, peat and petroleum was stored by the activity of plants in the dim past. It represents our capital stock of usable energy and once dissipated can not be recovered. The energy in wood, sugar, plant and animal oils and fats released by burning or by the metabolism of living things is that part of the sun's energy stored in our time. This can be regenerated within a reasonable period by the activity of plants now growing. Other sources of power, water power, wind power, power from the tides, are minor in comparison with the energy which has been and is being stored by the photosynthesis of plants.

The major features of this essential process were discovered and elaborated by Joseph Priestley, Ingenhousz, Boussingault and others over a period of about 100 years beginning in 1771 and are taught in every course in botany and biology. The details of how chlorophyll works are, however, still unknown, and the basic and essential character of the process is not yet a part of our national thinking. If it were, the small group of men who are attempting to discover how photosynthesis occurs—that is, how plants store the sun's rays—would receive more encouragement and assistance than they do, and in the discussions of the future of synthetic rubber made from petroleum we would see some consideration given to the wisdom, from the long view, of using petroleum in quantity to make something which can be produced from the air and water by the activity of plants.

Perhaps the significance of photosynthesis for our mechanical age could be more clearly grasped if it were possible to prepare a balance sheet on the world's store of available energy and the rate at which it is being dissipated. This can not be done. We can say that the coal and petroleum burned annually represents a net loss of potential energy, and we can also say that in time, though not in what time, we will have to depend upon the energy fixed annually by plants unless some other source at present not at our command, for example, atomic energy, is discovered and methods for its utilization devised.

How much energy is fixed annually by plants? Abbot has estimated that the energy given off by the sun amounts to the equivalent of 4×10^{23} tons of coal annually, of which the earth intercepts a small fraction, the equivalent of 2×10^{14} tons of coal. According to Berle, plants fix each year 2.7×10^{11} metric tons of carbon, which is the equivalent of somewhere near 3×10^{11} tons of coal. If these figures are approximately correct, then about 0.5 per cent. of that part of the sun's energy which falls on the earth is caught annually and stored by plants.

Another set of data leads to somewhat the same con-

[1] Address of the vice-president and chairman for 1943 of the Section on the Botanical Sciences, American Association for the Advancement of Science, Cleveland, September, 1944.

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clusion. Transeau calculated that 1.6 per cent. of the sun's energy was utilized by a field of corn in Illinois during the 100 days of its growing season. Since for much of the rest of the year a corn field lacks vegetation it would appear that something less than 1 per cent. of the sun's energy annually reaching corn land in Illinois is fixed. In some parts of the tropics and other sections of the world where vegetation is active the year round this proportion would be larger; on the other hand, in the arctic, in deserts and a considerable part of the ocean it would be much less. We may be justified, therefore, in assuming that the annual energy fixation of plants approximates the equivalent of 3×10^{11} tons of coal.

This astronomical figure is at first sight quite comforting, particularly when we learn that in energy value it is over 200 times the coal and oil burned in 1938. The difficulty is that most of this annual income is not used. Wood, alcohol produced in fermentation and plant waste plays but a minor part in furnishing heat or mechanical energy because of their inconvenience, expense or lack of adaptability to modern machinery.

Berle has reported a method by which motor fuel equal in many respects to petroleum can be produced from cellulose, starch, sugar and other carbohydrates, thus offering the possibility of replacing our stock of usable stored energy by utilizing part of the current day-to-day income. Carbohydrates only can be used by Berle's method; lignin, protein, oils and fats are unsuitable as crude materials. However, if all the carbohydrates in all the plants were used as Berle suggests, and this is obviously impracticable, we would have but 6 times the present annual consumption of petroleum and less than 2 times the equivalent of the annual world consumption of petroleum and coal. If all the world used coal and petroleum as we did in this country in 1942, the total energy fixed by plants would be but 25 times that dissipated and all the carbohydrates made each year would yield about one third the amount the world would need.

Two years ago the National Science Fund asked a representative group of outstanding scientists to list the problems with which scientific research should be concerned in the post-war era and on which special emphasis should be placed. Future sources of energy stood third on the list. Its importance was surpassed, in the judgment of these men, only by the analysis and study of human behavior and the general field of medical problems.

I shall not linger long on the second characteristic of plants so necessary for the existence of other life on this planet; that is, their ability to construct from simple and elementary substances types of chemical compounds essential for animals. Their capacity for making sugar from carbon dioxide and water, constructing amino acids from inorganic nitrogen and organic-carbon compounds and for synthesizing vitamins enables us to live. Plants are able chemists and there is no substitute for them.

Plants and Research in Science

It would seem perhaps appropriate to terminate a discussion of the importance of the plant kingdom after having pointed out the essential relation of plants to our sources of energy and the dependence of all life on their existence. However, plants do more than fill our stomachs, warm our bodies and help us to go quickly from here to there. For example, plants are useful for the investigation of problems in science. For this purpose they have certain advantages. They can be grown in large numbers, and we have no compunction in destroying them in quantity if it is desirable for the purposes of the research. Their firm, well-delineated cell walls, general structure and methods of reproduction make them well adapted to the investigation of certain kinds of problems, and their infinite variety in morphology and physiology offers opportunity to select an organism best fitted to serve as experimental material for attack on a particular question.

The study of plants played a major part in the development of our knowledge of cells and the formulation of the cell theory. Cells were first described by Robert Hooke in 1665 from charcoal, cork and other plant tissues. The discovery of the nucleus is generally ascribed to Robert Brown, botanist, who made his announcement in 1831. The first careful description of cell division we owe to the botanist Hugo von Mohl, who introduced the term protoplasm in its present sense. Chromosomes were figured by the botanist, Anton Schneider, in 1873 and first adequately described by Strassburger in 1875.

In many other directions we find that research with plants has led to fundamental discoveries. The investigations of Payen and Persoz in 1833 on the diastatic activity of germinated barley opened the door to the field of enzymes. Mendel's laws, the foundation of our understanding of heredity and genetics, were discovered by experimenting with peas. The idea of hormones was first presented by the botanist Sachs in 1880. The essential nature of the so-called minor essential mineral elements, for example, manganese, copper and zinc, was demonstrated by Bertrand and his coworkers for the black mold *Aspergillus niger* considerably before their importance in animal nutrition was recognized. The discovery of the nature of virus diseases to which belong the agents responsible for smallpox, yellow fever, influenza, poliomyelitis, virus pneumonia, foot and mouth disease, hog cholera,

rabies and many other afflictions of man, animals and plants began with experiments by Iwanowski in 1892 on the mosaic disease of tobacco and was completed by Stanley in 1935 by the isolation from tobacco afflicted with mosaic of the active agent as a nucleo-protein of high molecular weight. The influence of day-length on reproduction was demonstrated for plants by Garner and Allard some years before the correlation of reproductive activity in animals and day-length was investigated.

Perhaps nowhere is the importance of work with plants for scientific objectives of general application demonstrated better than that which has been carried on with yeast. Pasteur's investigations on fermentation contributed in a major way to the germ theory of disease and to his later discoveries in the field of medicine. Investigations on the chemical changes induced in carbohydrates by yeast have had an immense influence on our knowledge of respiration and the intermediary metabolism of carbohydrates in animals, including man. At least two vitamins, pantothenic acid and biotin, were discovered from a study of yeast.

Many other examples could be cited illustrating the importance of research on plant material. What I have said, however, will suffice to show that the study of plants has given us in the past, as it will in the future, concepts of general significance in biology, a knowledge of principles applicable to other living things, including ourselves.

Recreational Value of Plants

I scarcely need call your attention to the recreational value of plants. The opportunity to enjoy flowers, shrubs and trees acts as an antidote for the artificiality and tension of city life, relieves the drabness and monotony so frequently associated with existence in a small town or in the country, and satisfies a deep-seated desire in all of us. It can not be expressed in units of value, though it has been recognized in art, poetry, architecture and design since the beginnings of recorded history. I see it evidenced by the thousands of films exposed by a part of the million or more people who visit the New York Botanical Garden annually; by the letters which come to my desk from those who feel impelled to tell me "the great pleasure it is to wander through flower gardens and conservatories and to spend quiet, peaceful, restful hours in the grounds," to quote from one of them; by the nearly 150,000 people who in 1938 attended the International Flower Show in the Grand Central Palace in New York City between Monday noon and the succeeding Saturday night with an admission charge of $1.10; by the universal interest in gardening and the numerous organizations associated with it, Garden Clubs, Rock Garden Society, Iris Society, Dahlia Society, Herb Society, Rose Society, Begonia Society, Succulent Society and so on; by the elaborate gardens maintained by the wealthy and the plants raised on window sills in country kitchen and city apartment.

Some one has said that gardening and a love of gardens are essential components of a full, sane and rounded life, and traffic with the soil and the green things that grow from it is one of the noblest and most healthful associations man may adopt. To own a bit of ground, dig it with a spade, plant seeds and watch them grow is a most satisfying thing, and fondness for such activity often comes back to a man after he runs the round of pleasure and business. As Henry Ward Beecher once wrote, every book which interprets the secret lore of fields and gardens, every essay that brings us nearer to an understanding of trees and shrubs and even weeds is a contribution to the wealth and happiness of man.

A garden gives the possessor fruit, vegetables and flowers; it also teaches patience and philosophy, pacifies and heals the body and the mind. This is recognized in the employment of gardening in occupational therapy by hospitals and prisons, a practice which has been used successfully and is increasing. This was not always so. Oscar Wilde, writing of his own experience in an English jail, said:

> But neither milk-white rose nor red
> May bloom in prison air
> The shard, the pebble and the flint
> Are what they give us there
> For flowers have been known to heal
> A common man's despair.

At the New York Botanical Garden some years ago we received an anonymous gift of money from an individual who stated that it was sent because the opportunity of enjoying the plantings in the Garden had prevented self-destruction. If one person was impelled to express his appreciation in this fashion there must have been many others less articulate or with smaller need who have felt the influence of plants in times of stress. I believe that in the brave post-war world many are now planning, gardening will be recognized and given an important place because of its occupational and spiritual values.

May I add a word of caution. We need nothing but our senses to enjoy the beauty of flowers, but the deeper satisfaction of knowing them and growing them requires a breadth of knowledge and experience surprising to the uninitiated. So long as any man out of employment is considered to be a capable gardener, and seed catalogues are looked upon as adequate texts, gardening is likely to be a series of disappointments

which only the persistent will survive. Gardening as a profession requires training, practice and a body of special information, as other professions do, and the amateur, whether individual or corporate, does well to look to the professional for guidance and for help. The Royal Botanic Gardens at Kew and at Edinburgh as well as similar institutions on the continent have long recognized gardening as a profession and have conducted courses of instruction in theory and practice. In this country few institutions have as yet concerned themselves with this aspect of education, though in the post-war period there is going to be a considerable need for it.

ECONOMIC IMPORTANCE OF PLANTS

Every one recognizes the economic importance of the common field crops, wheat, oats and corn, of the vegetables and fruits and of lumber. These are items in our everyday living. Not every one realizes, however, how many other products are obtained from plants. They are the source of linseed oil, corn and coconut oil, turpentine, lacquer, varnish and resin, coffee, tea and other beverages, perfumes, flavorings and spices, drugs and insecticides, paper, cordage and clothing, cellulose for artificial silk and a hundred other useful products. The plant extractives industry alone, including drugs and flavorings, probably amounts in the United States to between 100 and 160 million dollars annually. It took a war, a war which cut us off from normal supplies, to make us appreciate how much our economy and our comfort and convenience depend upon many of these plant products from distant places. Rubber and quinine are two of the most generally known, but there are many others, for example, the sponge of the luffa gourd, the insecticide pyrethrum, chicle for chewing gum, the drug ergot, agar agar and cork. And yet in spite of the varied materials we now obtain from plants the potentialities of the plant world are but partially explored. What might be called economic botany is largely an inheritance from our untutored ancestors who obtained their information over the centuries by trial and error. Very little systematic effort has been made to explore the plant kingdom with the idea of exploiting products as yet unknown or unused. The wide contacts brought through this war to hundreds of thousands of our young men, many of them already trained in science, may result in new and important uses for plants. The opportunity exists because not only are familiar plants incompletely investigated, but there are considerable areas of the earth botanically unexplored and thousands of species of plants still unknown to science. Any one of them might become as important to us as *Penicillium notatum*.

I can not close this discussion of the economic aspects of plants without referring to their importance in disease and decay. It is not my intention, however, to discuss bacteria, yeasts and molds as causes of disease in other plants and in animals and man nor to elaborate on their relation to decay except to call attention to the importance of the fungi in rotting wood and cloth, molding food, short circuiting electrical instruments and deteriorating optical equipment in the tropics. Although those of us who live in the temperate zone are acquainted with the fungus rots of telephone poles, railroad ties and house timbers and the minor losses from mildewed curtains or moldy food, we have little conception of the destructiveness of molds in the moist tropics. Their control is a matter of major concern.

Another way in which plants contribute to our economic system is through the association of microorganisms in the formation of various products, for example, cheese which depends upon the activity of the lactic acid and other bacteria and various molds; beer, wine and other fermented liquids produced by yeast; sauerkraut, vinegar, soy sauce and many others less well known or desirable. Bacteria, yeasts and molds as we learn to know them better are increasingly used for producing specific chemical compounds which are beyond the skill of the laboratory worker or which can be made more cheaply by the microorganism. Alcohol, acetic acid, acetone, glycerine, citric acid, gluconic acid and riboflavin are some of these compounds. The most recent and illustrious addition to this list is of course penicillin.

"Botany," said Thomas Jefferson, "I rank with the most valuable sciences whether we consider its subjects as furnishing the principal substances of life to man and beast, delicious varieties for our tables, refreshments from our orchards, the adornment of our flower-borders, shade and perfume of our groves, materials for our buildings or medicaments for our bodies."

Jefferson wrote these words in 1814. Priestley had but recently demonstrated that plants produce oxygen; the uniqueness and importance of photosynthesis was still to be recognized; coal and petroleum were still to be developed; vitamins and amino acids, the relation of plants to them and their importance in animal nutrition were unknown; rubber was a plaything; the relation of bacteria and molds to disease and decay was still to be discovered and penicillin was a long way in the future. Thomas Jefferson estimated the importance of plants on the basis of the knowledge about them available in 1814. What would he have said to-day?

OBITUARY

RAYMOND ROYCE WILLOUGHBY

RAYMOND ROYCE WILLOUGHBY died at his home in Riverside, R. I., on October 3, 1944. He left his wife, Miranda Willoughby, and four children. At the time of his death he was chief of the Division of Research and Statistics in the (R. I.) State Department of Social Welfare. He is better known to readers of SCIENCE for his many publications in the field of psychology, and for his work with the *Psychological Abstracts*.

Dr. Willoughby was born in New Haven, Connecticut, on April 20, 1896. He received the degree of Sc.B. from Massachusetts Agricultural College in 1919. He studied for a time at Harvard, and then went to Stanford, where he received his A.M. in 1923 and his Ph.D. in 1926. He was then appointed associate editor of the *Psychological Abstracts*, which had just been started by the American Psychological Association. He served in this capacity until 1940, when he resigned to accept his research position. During this period of 14 years he also held the title of research associate, first at Clark and then at Brown, when the editorial office moved to that institution.

Dr. Willoughby's first publication was with L. M. Terman, in the famous "Genetic Studies of Genius." Many of his later publications show the influence of Terman's instruction, for they were concerned with statistical analyses of familial characteristics. But his research interests soon spread to other fields, especially that of emotional adjustment. His Clark Revision of the Thurstone Personality Inventory is widely known. Less well known is his individual work in the same field. Friends came to him with their personal problems, and found that they themselves could work out the solutions in the presence of a sympathetic listener. Dr. Willoughby found this work very satisfying, and soon learned to guide the discussion to the heart of the problem by an occasional question.[1] Dozens, perhaps hundreds, of his friends owe much to this sympathetic help. He soon realized that he could contribute most to human happiness by helping key people, as teachers and ministers. During his last two years he had this opportunity. He became associated with a group of ministers, and taught them his methods of helping people with their problems. He felt that this work was the most important thing he had ever done. Thus, although he died in mid-life, he will live in the work of others.

CLARENCE H. GRAHAM
J. MCVICKER HUNT
WALTER S. HUNTER
HAROLD SCHLOSBERG

[1] *Jour. Abn. and Soc. Psychol.*, 26: 125–130, 1931.

WARREN L. BEUSCHLEIN

WARREN L. BEUSCHLEIN, professor of chemical engineering at the University of Washington, Seattle, died on September 15, at the age of forty-nine years. Professor Beuschlein was graduated from the California Institute of Technology in 1920 and received the M.S. and Ch.Eng. degrees from the University of Washington in 1925 and 1935, respectively. From 1919 to 1922 he was chemical engineer and plant manager of the American Nitrogen Products Company. In 1922 he came to the University of Washington as instructor in chemical engineering and in 1937 became professor of chemical engineering. He was one of the first to carry on studies in the hydrogenation of coal and was active in the problems of the pulp and paper industry, charcoal production and wood products. During the war he served as senior gas officer for the City of Seattle.

H. K. BENSON

UNIVERSITY OF WASHINGTON,
SEATTLE

RECENT DEATHS

DR. GEORGE DAVID BIRKHOFF, Perkins professor of mathematics at Harvard University from 1935 to 1939, dean of the faculty of arts and sciences, died on November 12 at the age of sixty years.

DR. MAX BERGMANN, biochemist, member of the Rockefeller Institute for Medical Research, died on November 7. He was fifty-eight years old.

DR. IRVING HARDESTY, professor emeritus of anatomy of Tulane University, died on November 7 at the age of seventy-eight years.

DR. HARRY VAUGHN HARLAN, principal agronomist of the U. S. Department of Agriculture, died on November 6. He was sixty-two years old.

JAMES ADRIAN BIZZELL, professor emeritus of soil technology of Cornell University, died on November 1. He was sixty-eight years old.

DR. THOMAS EWING FRENCH, professor emeritus of engineering drawing of the Ohio State University, died on November 2 at the age of seventy-three years.

SCIENTIFIC EVENTS

THE CEYLON ASSOCIATION OF SCIENCE

IT is reported in *Current Science*, India, that the Ceylon Association of Science was formally inaugurated on July 29 at a meeting held at the University of Ceylon. The association is designed closely on the lines of the British Association for the Advancement of Science and the Indian Science Congress. The objects of the association are the advancement of pure

and applied science in the Island, the holding of an annual session and the dissemination of scientific knowledge. Membership in the association consists of three classes: foundation members, sessional members and student members.

D. N. Wadia, mineralogist of the Ceylon Government and a former president of the Indian Science Congress, was elected general president of the association, and Dr. V. Gabriel, senior surgeon, General Hospital, Colombo, was chosen the president-elect.

For the purpose of discussion at the annual session the following sections have been formed: (1) *Medical and Veterinary Sciences,* President, Professor W. A. E. Karunaratne; (2) *Agriculture,* President, Dr. R. V. Norris; (3) *Engineering,* President, Professor R. H. Paul; (4) *Natural Sciences,* President, The Very Reverend Fr. M. J. Le Goc; (5) *Physical Sciences,* President, Professor A. Kandiah. Officers for an additional section, in which psychology, social sciences and education will be included, had not yet been elected.

It is proposed to hold the first session of the association as early as possible in the coming year.

"GENERA ET SPECIES PLANTARUM ARGENTINARUM"

THE first volume of this great projected work appeared late in 1943 under the editorship of Dr. Horacio R. Descole, director of the Instituto Lillo of the University of Tucuman, and published by Guillermo Kraft Ltda., Buenos Aires. An elephant folio of three hundred and seventeen pages with four-inch margins, bound in natural finished buckram, its format and typography are somewhat in the classical tradition of such works as "Flora Brasiliensis." Volume I contains comprehensive treatments of the Argentine representatives of three families: the Zygophyllaceae, by H. R. Descole, C. A. O'Donell, and A. Lourteig; the Cactaceae, by A. Castellanos and H. V. LeLong, and the Euphorbiaceae, by A. Lourteig and C. A. O'Donell. One hundred and eight pages of line drawings, ten pages of colored plates and fifteen pages of photographs with twenty distributional maps illustrate and supplement the discussions of these families. Appended are eleven colored plates of "Icones Plantarum Argentinarum."

Dr. Descole informs me that Volumes II and III will be published this year, one of them dealing exclusively with Argentine Gramineae by Dr. Castellanos. Additional volumes are in preparation. Apparently contributions by foreign botanists will, in certain instances at least, be included since the treatment of the genus *Nicotiana* is to be prepared in this laboratory.

The character and quality of the first volume of this outstanding contribution to South American botany is a tribute to the stature and maturity which plant taxonomy and geography have attained in Argentina and to the enthusiasm and scholarship of Dr. Descole and his associates in the Instituto Lillo.

T. H. GOODSPEED
UNIVERSITY OF CALIFORNIA

THE MINNESOTA ACADEMY OF SCIENCE

DUE to conditions brought about by the war the customary fall meeting and outing of the Minnesota Academy of Science have been dispensed with again this year.

The twelfth annual meeting convened on April 22 at the University of Minnesota. The following officers were elected for the year 1944–45: *President,* Dr. Charles Sheard, Mayo Foundation, Rochester; *Vice-president,* Dr. John E. Anderson, University of Minnesota; *Councilor,* 1944–1948, Sister Magna Werth, College of St. Benedict, St. Joseph. As retiring president of the academy Dr. George A. Thiel, University of Minnesota, became a member of the council for two years.

At the general morning program of the annual meeting three papers dealing especially with the post-war era were read.

The afternoon was devoted to the programs of the various sections. Dr. Dwight E. Minnich, of the department of zoology of the University of Minnesota, was chairman of the Section for Biological Science, at which nine papers were presented. Seven papers were read before the Section for Physical Science, with Andrew Hustrulid, agricultural engineering, University Farm, St. Paul, presiding. O. A. Nelson, Central High School, St. Paul, was chairman of the Section for Science Education, where five papers were read. The Section for Social Science, of which Dr. Lowry Nelson, sociology, University Farm, St. Paul, was chairman, heard reports from seven men of the University of Minnesota staff on "The Impact of the War on Red Wing, Minnesota." These men and others are making a comprehensive study of Red Wing as it has been affected by the war.

Tallies at the registration desk indicated an attendance of over 160.

Simultaneously the Minnesota Junior Academy of Science held its seventh annual meeting. The newly elected officers were: *President,* Miss Jean Drum, North High School, Minneapolis; *Vice-president,* Bruce Clark, St. Cloud Technical High School; *Secretary-Treasurer,* Miss Theresa Mulrean, St. Cloud Technical High School. Wesley Zimmerman, Paynesville High School, and Jack Anderson, Stillwater High School, were chosen for American Association for the Advancement of Science awards for 1944 because of their meritorious work in science. Ten papers were presented at the morning session. The afternoon was devoted to observing science exhibits, the showing of science movies and a tour of the Nat-

ural History Museum of the University of Minnesota conducted by William Kilgore, curator.

April 21, 1945, has been selected as the date for the next annual meeting of the academy.

JOHN W. MOORE,
Secretary

THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT a meeting of the American Academy of Arts and Sciences, held at Boston on the evening of November 8, a symposium was presented on "Blood and Blood Derivatives in War and Peace" at which the following papers were read:

"Blood Is a Very Special Juice" (—Goethe, *Faust*), Dr. Edwin J. Cohn.

"The Use of Blood and Blood Derivatives in Medicine," Dr. Charles A. Janeway.

"The Use of Blood Derivatives in Surgery," Dr. Franc D. Ingraham.

This report by members of the faculty of the Harvard Medical School concerned chemical, clinical and immunological work carried on by a large group of investigators whose cooperative endeavors during the war have greatly advanced knowledge regarding blood and its uses. The research has been carried forward with the cooperation of the National Research Council, the American Red Cross, the Massachusetts Antitoxin and Vaccine Laboratory, and other agencies and institutions, under contract as recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Harvard University.

There was an exhibit of the blood and blood derivatives that are being distributed to the Armed Forces.

MEETINGS OF MATHEMATICIANS

THE fifty-first annual meeting of the American Mathematical Society will be held at the Museum of Science and Industry, Chicago, on November 24 and 25, in conjunction with meetings of the Mathematical Association of America.

Sessions of the society will begin on Friday at 2:00 P.M. and continue through Saturday afternoon. Sessions of the association will be held on Saturday evening and Sunday morning. All sessions will be held in the west lecture hall of the museum.

The eighteenth Josiah Willard Gibbs Lecture will be given on Friday at 7:45 P.M., by Professor John von Neumann, of the Institute for Advanced Study, Princeton, N. J. The title of this lecture is "The Ergodic Theorem and Statistical Mechanics."

On Saturday at 2:00 P.M., by invitation of the Program Committee, Professor Will Feller, of Brown University, will deliver an address on "Limit Theorems in the Theory of Probability."

The annual business meeting and election of officers will be held on Saturday at 9:30 A.M. Following this the winner of the Cole Prize in Algebra will be announced and the recipient will give a résumé of the prize-winning memoir.

The Board of Trustees will hold its regular annual meeting at 6:00 and the council will meet at 9:00 P.M. on Friday at the Hotel Windermere East.

There will be a dinner for the two organizations and their guests at 6:00 P.M. on Saturday at Hotel Windermere West.

THE PRESIDENCY OF THE AMERICAN CHEMICAL SOCIETY

ELEVEN representatives of science and industry have been placed in nomination for the presidency of the American Chemical Society. The candidates were proposed by the local sections of the society, of which there are a hundred and six in all parts of the country. The choice will be made by mail ballot of the 40,000 members of the society. The nominees are:

Dr. Leason H. Adams, director of the Geophysical Laboratory, Carnegie Institution of Washington; Colonel Bradley Dewey, president of Dewey and Almy Chemical Company, Cambridge, Mass., formerly Rubber Director; Dr. Gustav Egloff, director of research of Universal Oil Products Company; Dr. Clifford Cook Furnas, director of the Airplane Division Research Laboratory of Curtiss-Wright Corporation, Buffalo, N. Y.; Dr. Milton Harris, director of research at the Textile Foundation, National Bureau of Standards, Washington, D. C.; Dr. Joel Henry Hildebrand, dean of the College of Letters and Science at the University of California; Dr. W. Albert Noyes, professor of chemistry at the University of Rochester; Dr. Walter A. Schmidt, president of the Western Precipitation Corporation, Los Angeles; Dr. Eugene Paul Schoch, professor of chemical engineering at the University of Texas; Dr. Lee Irvin Smith, professor and chief of the Division of Organic Chemistry of the University of Minnesota; Dr. Charles Allen Thomas, central research director, Monsanto Chemical Company, Dayton, Ohio.

The nominee who receives the largest vote will become president-elect on January 1, 1945, and president on January 1, 1946. Professor Carl Shipp Marvel, of the University of Illinois, the present president-elect, will assume the presidency on January 1 next, succeeding the late Thomas Midgley, Jr.

SCIENTIFIC NOTES AND NEWS

AN Associated Press dispatch from Stockholm dated November 9 reports that the Nobel Prize in physics for 1943 has been awarded to Dr. Otto Stern, research professor of physics at the Carnegie Institute of Technology, Pittsburgh, who has now leave of absence to enable him to engage in research for the Govern-

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ment. The prize for 1944 has been awarded to Dr. Isidor Isaac Rabi, professor of physics at Columbia University. The prize in chemistry has been awarded to Dr. Georg Hevesy, of Copenhagen. The committee reserved the prize in chemistry for 1944 for possible award next year.

THE Gorgas Medal for distinguished service as an officer of the Medical Corps, United States Navy, in the field of preventive medicine for the armed forces, was presented *in absentia* to Commander James J. Sapero at the annual dinner in New York City on November 3 of the Association of Military Surgeons of the United States. The medal, which was established in 1942 and which is sponsored by Wyeth Inc., was awarded to Commander Sapero in recognition of his work in organizing the series of malaria control commissions which now operate in every area in the South Pacific infested by infected anopheles.

THE American Welding Society has awarded the Lincoln Gold Medal to Dr. Wendell F. Hess, head of the welding laboratory of the Rensselaer Polytechnic Institute, and to D. C. Herrschaft, an assistant, for a paper "representing the greatest contribution to the advancement and use of welding for the year 1944."

THE Associate Alumni of the College of the City of New York has awarded the Townsend Harris Medal "for postgraduate achievement" to William Fondiller, assistant vice-president of the Bell Telephone Laboratories. The formal presentation will take place at the annual dinner of the alumni on November 18.

THE Honor Scroll Award of the American Institute of Chemists was presented at a testimonial dinner on October 6 to Robert Brinton Harper, vice-president of the Peoples Gas Light and Coke Company, Chicago, in recognition of "distinguished service to the gas and allied industries, as organizer, executive and scientist."

DR. HARRY M. HINES, professor of physiology at the College of Medicine of the State University of Iowa, has been made head of the department. He succeeds Dr. John T. McClintock, who has retired after serving for forty-two years.

DR. NORMAN J. VOLK, head of the department of agronomy and soils of the Alabama Polytechnic Institute and Station, has been appointed head of the department of agronomy of Purdue University, to succeed Dr. George D. Scarseth, who resigned recently to become director of the American Farm Research Association.

DR. STANLEY B. FREEBORN, senior surgeon in the U. S. Public Health Service, has resumed his work as professor of entomology and assistant dean of the College of Agriculture of the University of California. He was called to active duty after Pearl Harbor to organize and administer the program of the U. S. Public Health Service for malaria control in war areas. Measures were taken to combat the spread of mosquito-borne epidemics in areas crowded with service personnel and war workers, as well as in tropical stations such as Puerto Rico and Jamaica.

DR. HERBERT E. LONGENECKER, professor of chemistry at the University of Pittsburgh and director of research projects of the Buhl Foundation at the university, has been appointed dean of research in the natural sciences. He will direct investigations in chemistry, physics, biology and allied fields.

PROFESSOR CLINTON N. LAIRD, since 1905 professor of chemistry at Lingnan University, in 1942 a repatriate on the *Gripsholm* from the Japanese Internment Camp at Hong Kong, and from January 1, 1943, to August, 1944, associated with the Foreign Economic Administration at Washington, has left the United States for Istanbul, Turkey, to become professor of chemistry at Robert College for three years. In 1947 he will retire from Lingnan University as emeritus professor of chemistry.

IT is reported in *Nature* that the University of Ankara has appointed the following, nominated by the British Council, to professorships in the sciences: Dr. W. J. McCallien, Carnegie teaching fellow in geology at the University of Glasgow, to the chair of geology, and Professor J. A. Strang, professor of mathematics at the University of Lucknow, to the chair of mathematics. British scholars occupy ten chairs at the University of Istanbul, including Professor F. H. Constable, physical chemistry; Professor P. du Val, mathematics; Professor V. H. Legg, industrial chemistry; Professor W. C. W. Nixon, gynecology; Professor J. S. Rankin, theoretical mechanics; Professor F. Royds, astronomy.

DR. LEONARD CARMICHAEL, president of Tufts College, has resigned as director of the National Roster of Scientific and Specialized Personnel of the War Manpower Commission. He is succeeded by Dr. George A. Works, formerly professor of higher education and dean of students at the University of Chicago.

DR. ROBERT H. FELIX has been appointed director of the division of mental hygiene of the U. S. Public Health Service, Washington, D. C. He succeeds Dr. Lawrence Kolb, retired.

DR. A. M. PORTER, associate professor of vegetable gardening at the University of Connecticut, has leave of absence to become principal seed specialist with the U. S. Foreign Economic Administration. In this position he will be in charge of the distribution of seeds, fungicides and insecticides to Allied and liberated countries.

DR. MAX R. ZELLE, assistant professor and assistant in animal genetics at Purdue University, has leave of absence to enable him to accept a commission in the United States Navy.

DR. LLOYD A. HALL, chief chemist, the Griffith Laboratories, Chicago, Illinois, has been appointed a member of the Food Standards Commission of the Illinois State Department of Agriculture.

DR. H. H. STORCH, of the Central Experiment Station at Pittsburgh, has been appointed chief of the research and development division of the Office of Synthetic Liquid Fuels of the U. S. Bureau of Mines. A laboratory will be erected at Bruceton, Pa., which is expected to be ready for occupancy next autumn.

BRIGADIER BASIL SCHONLAND, professor of geophysics at the University of the Witwatersrand, Johannesburg, now of the South African Corps of Signals, who is serving on General Eisenhower's staff, has been appointed head of a new industrial research institution for the Union of South Africa.

DR. J. LEE DEEN, station forester and dean of forestry and range conservation at Colorado College, has leave of absence for about seven months to make a survey for the American Forestry Association of forest resources in Colorado, Wyoming, Utah, New Mexico and Arizona. He will be assisted by J. C. H. Robertson.

E. J. ALEXANDER, assistant curator at the New York Botanical Garden, and Thomas MacDougall, a nurseryman and landscape designer of New York City, plan to spend six months exploring little known parts of southern Mexico for botanical and horticultural material. This is the second tropical expedition of the New York Botanical Garden within the past year. Dr. Bassett Maguire, curator, returned at the end of October after a trip of eight months during which he explored the savannahs above Kaieteur Falls in British Guiana, also Table Mountain in the interior of Surinam. In addition, Dr. H. W. Rickett, bibliographer, spent the summer of 1943 in Mexico as a representative of the Inter-American Committee for Artistic and Cultural Relations.

THE A. Walter Suiter Lecture of the New York Academy of Medicine was delivered on November 2 by Dr. Stuart Mudd, professor of bacteriology at the University of Pennsylvania. His lecture was entitled "Airborne-Infection—The Rationale and Means of Disinfection of Air."

DR. R. RUGGLES GATES during the period from October 20 to November 14 gave at the Lowell Institute, Boston, a series of eight illustrated lectures on "Human Heredity."

PROFESSOR EDWARD KASNER on October 20 gave an invited address at St. John's College, Annapolis, on "Geometry and Mechanics," and an address entitled "The Golden Section" at the opening meeting of Friends of Scripta Mathematica at Columbia University on October 26.

DR. S. H. KNIGHT, of the department of geology of the University of Wyoming, who has been a visitor at the department of geology of Columbia University, delivered a lecture entitled "Physical Evolution of the Rocky Mountains" before the New York Academy of Sciences on the evening of November 6. He planned also to lecture before the departments of geology at Vassar College, Smith College and Wellesley College, and before the Society of the Sigma Xi at Brown University.

THE two hundred and sixty-fifth meeting of the American Physical Society, which will take the place of the 1944 annual meeting, will be held at Columbia University in New York City on January 19 and 20, 1945. There will be a symposium on "The Physics of the Solid State," including papers which pertain to mechanical properties, magnetism and order-disorder phenomena, as well as to other aspects of the field. The American Association of Physics Teachers will meet at the same time and place.

THE Texas Academy of Science met on November 9, 10 and 11 under the auspices of the Medical Branch at Galveston of the University of Texas. A special feature of the meeting was a symposium on November 11 on the biology of the cancer cell, under the chairmanship of Dr. W. A. Selle, of Galveston. Participating were Professors R. E. Hungate, Alfred Taylor, T. S. Painter and R. J. Williams, of the University of Texas, Austin; and Dr. Fritz Schlenk, of Houston; Professor J. A. Cameron, of Dallas, Paul Brindley, of Galveston, and Dr. Selle. There was a symposium on health conditions in the coastal area of Texas, under the chairmanship of Dr. J. G. Sinclair, professor of anatomy.

THE next regular meeting of the Instrument Society of Washington will be held on November 21, at 8:00 P.M., in the Auditorium of the Interior Department, 18th and C Streets, N.W., Washington, D. C. C. G. Weinott, of the Engineering Department of the Westinghouse Electric and Manufacturing Company, will speak on "Fractional Horsepower Motors—Their Characteristics and Instrument Applications." Admission is open to the public.

IT is reported in *The Times*, London, that an international agreement on a world-wide uniform standard and unit of penicillin has been reached by the Health Committee of the League of Nations at a meeting held at the headquarters of the Royal Society, Burlington House, with Sir Henry Dale,

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president of the society, in the chair. Delegates who attended were from *Australia,* Major J. L. Bazeley, Commonwealth Serum Laboratories; from *Canada,* Dr. G. D. W. Cameron, chief of the Laboratory of Hygiene, Department of Pensions and National Health, Ottawa; from *France,* M. le Dr. J. Trefouel, director of the Pasteur Institute, Paris; from the *United Kingdom,* Dr. C. R. Harington, National Institute of Medical Research; and Dr. J. W. Trevan, Wellcome Physiological Research Laboratories; and from the *United States,* Dr. R. D. Coghill, Northern Regional Research Laboratory of the U. S. Department of Agriculture, Peoria, Ill.; Dr. R. P. Herwick, chief of the Drug Division of the Food and Drug Administration, and Dr. M. V. Veldee, chief of the Division of Biologics Control, U. S. Public Health Service. Other countries sending observers include India and South Africa.

AT the annual general meeting on October 17 of the British Standards Institution, The Right Honorable Lord Woolton was elected president and Sir Percy Ashley was elected vice-president. Sir William Larke succeeded Sir Percy Ashley as chairman of the General Council. Dr. E. F. Armstrong, F.R.S., chairman of the finance committee, reported that income and expenditures for the year had increased by twenty-eight per cent. and was now about £69,000. The sales of copies of British Standards had gone up thirty-nine per cent. The Government grant-in-aid was nearly double and was now £12,900. While there was an increase of some fifteen per cent. in the number of subscribing members he pointed out the need for greater support from local authorities and industry.

AT the request of the departments of the public health and mosquito abatement districts in California, the School of Public Health of the University of California will offer from December 5 through December 16, in cooperation with the College of Agriculture, an intensive, practical course on the control of mosquitoes and mosquito-transmitted diseases, covering instruction in administration and management, entomology and parasitology, mosquito-transmitted diseases and techniques of control.

THE post-war building plans of the Santa Barbara College of the University of California include the erection of a science building and of a library and administration building.

DISCUSSION

POST-WAR BIOLOGY REHABILITATION[1]

IN August, 1944, a group at the Marine Biological Laboratory at Woods Hole invited a representative of the Department of State to address the scientific community at Woods Hole. Mr. G. Howland Shaw, Assistant Secretary of State, sent, as his representative, Dr. Ralph E. Turner. As a result of stimulating sessions with him a memorandum was prepared expressing the interest of the biologists in participating with the State Department in efforts toward rehabilitation of the basic biological sciences during the post-war period.

Briefly stated, the memorandum recommends closer cooperation than hitherto among scientists throughout the world. The need for rehabilitation as a result of war devastation is presented as an opportunity for furthering such cooperation. Suggestions are offered (1) of increased support toward international scientific congresses taking into consideration the inestimable value of frequent personal contacts; (2) of the establishment of representatives of the basic sciences in governmental embassies to enhance close coordination of scientific investigations; (3) of prompt rehabilitation of scholars of the basic sciences with needed laboratory and library equipment; (4) of the establishment of short- and long-term exchange fellowships and professorships.

[1] Memorandum prepared at the Marine Biological Laboratory.

This memorandum was sent to the Department of State on August 31, 1944, and, as a record of its active interest, the following paragraphs are quoted from the letter of acknowledgment of Mr. Shaw:

> The proposals embodied in the memorandum, which has been referred to the Division of Cultural Cooperation for study, seem to me to be excellent starting points for formulating a general program of scientific exchanges. The reestablishment of relations with the scientists of the Axis countries is, indeed, a delicate matter that must be given careful consideration by both scientists and governments. Inasmuch as the Department has begun only recently to study the place of science in the general cultural relations program, it welcomes the cooperation of your group in this work. In fact, the Department is convinced now that a proper place can be given to science in this program only if full cooperation can be organized between the scientists, especially through their professional organizations, in the various fields and the Department. I assure you, therefore, that the Department will welcome further opportunities to consider with your group the international interests of biologists.

The memorandum was presented to several sections of the American Association for the Advancement of Science at its meeting in Cleveland, September 11–16, 1944. It was approved in principle and has been transmitted to the executive committee of the association for final action.

A memorandum similar in scope has been recently and independently prepared by Joseph Needham at Cambridge University and was sent to our National Research Council for consideration. It is entitled "Memorandum on an International Science Cooperation Service."

In the last published Report of the National Academy of Sciences for 1942–1943, the extent to which international matters have been considered, aside from those already referred to here, is the following: In a conference held on August 7, 1942, between one of the secretaries of the Royal Society of London and the chairman of the Division of Foreign Relations, it was agreed that "after the war opportune cooperative understandings with learned societies of previously hostile nations might be a better way of restoring mutual friendship and respect than an attempt now, on our part alone, to fix a definite policy for collaboration."

The purpose of Needham's memorandum and that prepared at Woods Hole go further in seizing the opportunity, presented by the immediate need of postwar restoration, to institute more intimate than hitherto long-range cooperation among workers in the basic sciences of all freedom-loving countries throughout the world.

The preparation of such a project should not wait for the termination of the war. At least two steps should be taken: (1) Contacts should be made to coordinate the activities of foreign and domestic relief committees which are engaged in plans for the rehabilitation of educational facilities in the war-stricken countries. Much of this effort is immediate, as emergency measures. In such efforts notable assistance is already being made by the Rockefeller Foundation to foreign scientists and to scientific institutions abroad. The Royal Society of London is also engaged in similar activities. (2) By means of Needham's and the Woods Hole memoranda or a combination or revision of both, there should be secured, at once, the collaboration of interested individuals and institutions both in the Americas and in other freedom-loving countries which have been least affected by the material damages of the war.

Ideas emanate from the least expected places. The broader the source and the wider the range of proposed ideas the more likely will be the chances of preparing a permanently working plan.

A comity of nations depends upon mutual respect for the differences which exist among them. There also exist threads of similarities, a chief one of which is the universal appreciation of science and the scientific method. This provides one of the surest approaches to international understanding and good will.

ROBERT CHAMBERS

NEW YORK UNIVERSITY

THE CONFLICT BETWEEN SCIENCE AND BIOLOGICAL INDUSTRY

BEGINNING a little more than fifteen years ago a number of public contact committees were set up in scientific organizations interested in biological problems. One function of these committees was to influence the legislative and executive branches of government. Very recently several of them have been abandoned or have become inactive. There is now a strong movement toward the building up of a central council representing various societies which would deal mainly with national problems. While a union can do an inestimable service in gathering information in Washington and in making contacts with officials and legislators, there is danger of reducing many voices to a single one.

It is now generally understood in the national capital that a scientific society should not exert pressure on governmental agencies or legislative bodies. Some of the objection is pure conservatism, in part due to the lack of any need in many fields of science. There is also a fear that there will be misrepresentation of research results. It may perhaps be granted that scientific societies and their members are not well equipped to contact Congress or government agencies directly. Usually there are not enough members not in government employ while residing in or near Washington, to make proper contacts. Such men as are available are otherwise employed and have been overburdened with calls by scientific organizations. The public pressure of scientific societies is of necessity conservative. One national society with especial needs for preserving study and check areas with their natural biological content has attempted to influence Congress or the National Administration only ten times, another only three or four times, in twenty years. The need for action is limited and will not ordinarily burden a scientific agency. This is especially true if the legislative plans and agency programs are made available to the society by a central body with contacts in the national capital.

At the present time there is one reason for scientific society reclusion which overshadows all others. It is a veiled call to desist from pressing the application of scientific criteria and principles because of conflicts between them and practices of biological industry. Such conflicts have been concentrated in recent years, due to wide application of the results of research to submarginal lands, which resulted from the recent drought and depression and to problems arising from the present war. They have been in evidence at many points involving questions ranging from nutritive value of oleomargarine[1] to the value of a grassland

[1] "Wartime Farm and Food Policy," Pamphlet No. 5. "Putting Dairying on a Wartime Footing," first edition, March, 1943; second edition, 1944. Iowa State College Press, Ames, Iowa.

check area for comparison with lands under industrial use. Conflict is indicated by F. E. Molin's "When and if it Rains,"[2] which rejects results of grazing research, and by various resolutions of livestock and dairymen's associations. These incidents are of the same general nature as the request handed to more than one prosecuting attorney to desist in his efforts because the results are bad for business. The word does not come to scientists in the form of the legal phrase "cease and desist." The natural procedure of the politician, frequently of the administrator, is to convince his opponent by suggestions of ineffectiveness and impropriety.

Agencies representing special fields of knowledge, some of it technical, can not make presentations through another less scientific agency. To minimize misconstructions and misrepresentations, public application of scientific principles and the needs of future research should be urged by the specialists themselves. Human society, which supports research, will hold scientific men and the societies which they constitute responsible for failure to urge the application of their knowledge directly and simply whenever it is in the interest of society to do so. No scientific society devoted to research should fail in fulfilling this obligation.

V. E. SHELFORD

UNIVERSITY OF ILLINOIS

BIOLOGICAL FIELD WORK IN BOLIVIA

MOST botanists and zoologists are eager to find a place to make headquarters in a country which suffers from lack of accommodation. It may be useful, therefore, to point out the advantages offered by a Jewish refugee agricultural colony known as Socobo (Sociedad colonizadora de Bolivia). Their office is in La Paz, and the post office box is Casilla Correo 975, La Paz, Bolivia.

The plantation consists of approximately 2,000 acres of rather steep land ranging in elevation from 3,400 feet to 5,500 feet on the Amazonian slopes of the Andes not far from the town of Coroico. The latter town is well known to plant explorers and provides only the most primitive accommodation. At Socobo one finds well-constructed concrete, screened houses with electric light and safe drinking water, none of which are possible in most of Bolivia. It is approximately seven hours by car from La Paz over rather dangerous roads, but perfectly passable during the dry season from May to December.

They have available houses which can be hired for a reasonable sum, and within a few hours by mule-back one can get from permanent glaciers to tropical jungle. Arrangements can also be made for the hiring of animals and men if necessary. The place is ideal to use as headquarters for ecological or taxonomic work in a part of the Andes providing excellent opportunities in both fields. Inquiries should be made directly to Socobo at La Paz, or they may be sent to Dr. Adalberto Lindenstadt, who may be addressed at Socobo, Coroico, Bolivia.

NORMAN TAYLOR

IMPROBABILITY AND IMPOSSIBILITY

LECOMTE DU NOÜY[1] has presented the problem of the determination of the color of an unexposed photographic plate as one practically and theoretically impossible of solution. Although we can not learn the absolute answer to this question, I believe that we could reach a highly probable conclusion.

As a practical approach to the problem we could make a series of measurements of the wave-lengths of light reflected from the photographic emulsion at either decreasing intensities or decreasing exposure times of the incident light. This might possibly be accomplished with existing spectrophotometric equipment or perhaps more sensitive instruments would be required. The data obtained could be used for graphical extrapolation to the wave-lengths at zero light exposure. To bring the results into the realm of vision we could make up a synthetic pigment which would give a reflection curve corresponding to the extrapolated wave-length curve.

This method might give results just as close to the truth as are many widely held scientific beliefs. I believe that any problem depending on the laws of nature is subject to a highly probable solution, with refinements in the technics available.

B. W. HOTTEN

PURDUE UNIVERSITY

SCIENTIFIC BOOKS

LOCOMOTION

Speed in Animals. By PROFESSOR A. BRAZIER HOWELL. 270 pages. The University of Chicago Press. $4.00. 1944.

PROFESSOR HOWELL'S book "Speed in Animals" results from his long-standing interest in comparative anatomy and behavior. The degree and extent of the author's interest has determined accordingly the scope, emphasis and organization of the subject-matter.

"Speed in Animals" makes the following contributions to existing literature and information: (a) View-

[2] American National Livestock Association, 515 Cooper Bldg., Denver, Colo., 1938.

[1] SCIENCE, 100: 334, 1944.

points are proposed and supporting facts marshalled on the relation of structure and form of animals to their survival or evolution. (b) Muscular groups and skeletal parts are functionally described in a composite manner and related to locomotion.

The muscular and skeletal characteristics of fishes and amphibians, reptiles and birds, monotremes and marsupials, and placental animals are functionally described. Throughout these descriptions, consideration is given to the significance of gross form and proportions. These subjects are approached systematically. Beginning with Chapter V, however, Professor Howell changes his approach and deals with the muscular system, axial skeleton, the arm, the leg, proportions and gait. All subjects are discussed as they relate to animal "speed" or, preferably, locomotion.

In the introduction it is argued that speed has been most important as a determining factor in animal survival since speed is one of the abilities to escape from enemies and to secure food. Reproductive behavior has "exerted little influence upon bodily form."

"Speed in reaching distant objectives" is classified into running (cursorial ability), hopping (saltatorial ability), flying (volant ability) and swimming (aquatic ability). These technical terms are used freely throughout the book.

It is proposed that no animal is perfectly fitted to its environment, but rather that each type has made compromises in structural adaptations. This has been necessary because of limitations, restrictions and imperfections of the basic ground plan of fishes.

"The fitness for their environment attained by fishes is a heritage that has pronouncedly modified the conformation of all terrestrial vertebrates." The "ground plans" of fishes and amphibians are reviewed and it is shown that their structural-locomotor systems evolved into those of reptiles and birds.

"What were the general characteristics of the immediate ancestors of placental mammals?" The protomammal must have been a rather small and lightly built carnivorous type with efficient locomotor equipment. It had endurance and agility. Probably its habitat was partly temperate rather than tropical. These characteristics are said to be necessary concomitants of warm-bloodness in animals.

The structures of monotremes and marsupials are reviewed and descriptively correlated wtih locomotor capacities.

A relatively long chapter deals with the locomotor mechanisms of placental mammals. Following a half-page discussion on insectivora there is about a page and a third of discourse on primate "speed."

Professor Howell describes the following groups of muscles and their functional relations to locomotor abilities: muscles of the shoulder, the brachium, the manus, the fore-limb, the pelvic limb and the leg and foot. Attention is called to various muscles which have become specialized for speed.

Chapter VI treats of the mechanical and functional features of the axial skeleton in relation to speed. Balance, strength and flexibility are considered. Special attention is given to the head and neck in relation to speed, as well as the ears, horns and antlers and tail.

The arm bones and manus of some selected animals are considered from an evolutionary viewpoint. These structures are mainly described as supporting mechanisms; they are not described in relation to the important behavioral modalities of grasping or prehension.

There follows a splendid discussion of the leg and foot as agents of locomotion.

In the chapter on proportions Professor Howell becomes somewhat quantitative in his descriptions and develops a number of skeletal indices. These will be of great interest to comparative anatomists as well as to behaviorists who are concerned with the significance of skeletal proportions for animal locomotion.

Chapter X, entitled "Gaits," is not without some systematic perspective, but the main emphasis is on the horse. The chapter suggests the early experiments and arguments of Leland Stanford and the influence of the discussions on the development of cinema-photography. Professor Howell develops the subject thoroughly. It is suggested that this section contains much information of great interest to horsemen if it could be written in a more popular style than the author has used.

A table on page 242 gives "World Records for the Horse." The table calls attention to the fact that accurate measurements of speeds of travel for a wide range of animal types are lacking. It seems possible, however, that more data are available on this topic than have been reproduced in "Speed in Animals."

Professor Howell summarizes his book in the last chapter. There is a selected bibliography of 132 titles and a short index.

Evaluation. Anatomists, especially comparative anatomists, will find "Speed in Animals" full of facts and accurate descriptions. Muscles and bones are described in action. The functional and molar viewpoint in anatomy is advanced and made more meaningful.

Those scientists interested in animal behavior are given what is often needed by them, namely, an understanding of structural mechanisms of animal activities.

Professor Howell has apparently attempted a marriage between the field of comparative anatomy and comparative behavior. The degree to which he has been successful must be judged by competent scientists in both fields. The problem which arises because methodology, including terminology, for describing activities of animals is not nearly as well developed as methodology in anatomy has not been solved by Professor Howell. This disparity has, however, placed him at a great disadvantage in writing "Speed in Animals." It is suggested that as science is currently organized and developed, the central problem to which Professor Howell addressed himself should have been attacked by authorities from fields of anatomy and behavior working in collaboration.

Professor Howell's position on the problem of how environment and behavior causally affected modification of structure is not clear to this reviewer. It seems that the assumption is made that changes in animals' environments and the subsequently modified behavior directly cause structural modifications. It is not clear that he fully considers the processes of selective elimination and "survival of the fittest." The causal relation of behavior to structural changes in the development of a species seemingly lacks full exposition in a subject content where this might be expected by a reader.

A check of the bibliography shows that the source material is predominantly drawn from the period of 1930's. Wartime conditions probably account for this time lag.

The reviewer regrets that "Speed in Animals" does not deal in a more comprehensive manner with the locomotor behavior of primates including man and that the behavior of prehension is not more adequately covered.

Perhaps it is yet too early for scientists to use effectively results from stroboscopic photography in analyzing the relations of animal structures to their actions. Professor Howell will find this technique of value in extending his field of interest.

Finally, it seems to the reviewer that the book could have been more fittingly entitled "Animal Locomotion."

C. R. CARPENTER,
Captain, Air Corps
THE PENNSYLVANIA STATE COLLEGE

STEEL IN ACTION

Steel in Action. By CHARLES M. PARKER. 218 pp. 18 illus. Index. Lancaster, Pa.: The Jaques Cattell Press. 1943. $2.50.

FOUR chapters of this book are alone worth the time even of a busy man to read and study, namely: "Steel in Our Daily Life"; "The Struggle for Raw Materials"; "The Steel Industries of the World"; "The Distribution and Control of Raw Materials." The author's acquaintance with these and related phases of the steel industry is well known to those who have followed his recent work. He also speaks from a wealth of knowledge contained in the records of the American Iron and Steel Institute. Every industrialist and every citizen has an interest in these vital components of world peace and of our present and future economic life. To all persons in these two categories —and this means every one—we strongly recommend the reading of these four chapters.

BRADLEY STOUGHTON

SPECIAL ARTICLES

ON THE Rh AND OTHER BLOOD FACTORS IN JAPANESE[1]

THE practical importance of the Rh factor in the pathogenesis of a specific form of fetal and neonatal morbidity, erythroblastosis fetalis, has stimulated studies on the racial distribution of the Rh factor and its several varieties.[2-5] As Levine[2,3] has shown, the incidence of erythroblastosis fetalis in any race is directly proportional to the frequency of negative reactions with anti-Rh_0 serum. With this serum the values of positive reactions in the white, colored and Chinese races are 85, 92–95 and 99 per cent., respectively. In terms of negative reactions one should expect a far greater frequency of erythroblastosis fetalis in the white, and almost none among Chinese. These expectations are amply borne out by clinical observations.

It was of interest to make parallel observations on Japanese individuals residing in the metropolitan area of New York City. Cell suspensions (2.5 per cent.) in saline were obtained from 150 individuals of Japanese parentage. These tests were carried out independently by each author and identical results were obtained. In addition to tests with the several varieties of anti-Rh sera and tests for the blood groups, the subgroups of A and the M and N factors were also studied.

[1] From the Laboratories of Flushing Hospital, Flushing, N. Y., and the Ortho Research Foundation, Linden, N. J.

[2] P. Lævine, SCIENCE, 96: 452, 1942.

[3] P. Levine and H. Wong, *Am. Jour. Obst. and Gyn.*, 45: 832, 1943.

[4] A. S. Wiener, SCIENCE, 96: 407, 1942.

[5] A. S. Wiener, R. B. Belkin and E. B. Sonn, *Am. Jour. Phy. Anth.* 2: NS 787, 1944.

The results of blood groupings and M and N typings are given in Table 1. For comparative purposes, the data for three other races are included.

TABLE 1

	White	Colored[5]	Chinese[3]	Japanese*
	Per cent.	Per cent.	Per cent.	Per cent.
O	45.0	47.1	30.0	26.0
A	41.0	28.2	34.0	40.0†
B	10.0	19.6	25.3	23.3
AB	4.0	5.1	10.7	10.7
M	29.2	29.0	23.3	30.0
N	21.2	28.3	22.0	16.6
MN	49.6	42.8	54.7	53.4

* This study.
† Among the Japanese bloods, the ratio of A_1 to A_2 was 5:1 if the intermediate type was calculated as A_2.

The anti-Rh sera employed in this study are in the order of the frequency of positive reactions in a random white population, anti-Rh_0, anti-Rh′ and anti-Rh″. The data obtained with these three anti-Rh sera are recorded in Table 2, in which the results for the Japanese as well as for the three other racial groups are given.

TABLE 2

	White	Colored	Chinese	Japanese*
	Per cent.	Per cent.	Per cent.	Per cent.
anti-Rh_0	85–87	95.5 (L) 92.0 (W)	99.3	98.0
anti-Rh′	70–73	46.0 (L) 29.2 (W)	93.0	85.4
anti-Rh″	30	29.2 (W)	no data	61.4

(L) indicates data of Levine[2]; (W) indicates data of Wiener.[6]
* This study.

The anti-Rh″ serum was generously supplied by Dr. Wiener. In accordance with his suggestion, this serum was diluted 1:5 in order to remove the effects of a concomitant agglutinin of another specificity. However, in our hands, it was necessary to interpret some of the weaker reactions, such as ±, as negative with the anti-Rh″ agglutinin.

From a practical standpoint, the most significant finding is the exceedingly low incidence of negative reactions with the anti-Rh_0 serum among the Japanese. As in the case of the Chinese, one may conclude that the incidence of erythroblastosis fetalis and of intragroup transfusion reactions should be very low among Japanese as compared to the white race. This is amply supported by the scarcity of reports of these conditions in the Japanese medical literature.

The findings with the Japanese bloods on the basis of the several antigenic components of the Rh factor are presented in Table 3 along with the corresponding data for white and colored races recently published by Wiener.

TABLE 3

Reactions with anti-Rh_0	anti-Rh′	anti-Rh″		White	Colored	Japanese
+	+	+	Rh_1Rh_2	19.2	7.3	47.25
+	0	+	Rh_2	14.8	21.9	13.35
+	+	0	Rh_1	51.2	21.2	37.40
+	0	0	Rh_0	2.2	41.6	0.00
0	+	+	Rh′Rh″	0.0	0.0	0.66
0	0	+	Rh″	0.3	0.0	0.00
0	+	0	Rh′	0.8	0.7	0.00
0	0	0	Rh neg.	11.4	7.3	1.34

The terminology of the Rh antigens given above is that recommended by Wiener.[6]

Aside from the very low incidence of Rh negative individuals among Japanese already mentioned, the most significant finding is the absence of the type Rh_0 which is so frequent in the colored race. In striking contrast is the high incidence of the phenotype Rh_1Rh_2 in Japanese as compared to that in the white and colored races.

Almost identical differences in white and colored individuals were observed by Levine[7] in tests with an active anti-Rh″ agglutinin produced by an Rh_1 individual. In tests with a potent anti-Hr serum all Rh_1Rh_2 bloods gave negative reactions. About 60 per cent. of Rh_1 bloods of white individuals and almost all colored individuals tested possessed the Hr factor.

These preliminary findings serve to illustrate the importance of comprehensive racial studies which could be carried out as soon as all varieties of anti-Rh sera become readily available. It can be expected that the final theory of the heredity of the Rh antigenic complex will emerge from or be confirmed by the statistical analysis of the various phenotypes in many racial groups, as in the case of the four blood groups.

ROBERT K. WALLER
PHILIP LEVINE

ON THE SPECIFICITY OF CHOLINE ESTERASE IN NERVOUS TISSUE[1]

RECENT investigations have provided evidence for a new concept of the role which acetylcholine may have in the mechanism of nervous action.[2, 3] The release and the removal of the ester are considered as an intracellular process directly connected with the nerve action potential at points along the neuronal surface. The ester released by a stimulus depolarizes the membrane by rendering it permeable to all ions. Thus, flow of current is generated (action potential) which

[6] A. S. Wiener, SCIENCE, 99: 532, 1944.
[7] P. Levine: Unpublished data.
[1] This work was aided by grants of the Josiah Macy, Jr., and Dazian Foundations.
[2] J. F. Fulton and D. Nachmansohn, SCIENCE, 97: 569, 1943.
[3] D. Nachmansohn, R. T. Cox, C. W. Coates and A. L. Machado, *Jour. Neurophysiol.*, 5: 499, 1942, and 6: 383, 1943.

stimulates the adjacent region. There the process is repeated, and the impulse in this way propagated along the axon. At the nerve ending, owing to the increased surface, there is less resistance and more flow of current enabling the impulse to cross the non-conducting gap. The flow of current is the transmitting agent.

The new concept is based, to a large extent, on studies of the enzyme choline esterase. Three essential features are: (*i*) the high concentration of the enzyme in nerves. The concentration is sufficiently high to make possible a rate of acetylcholine metabolism which parallels that of the electric changes. (*ii*) The localization of the enzyme at the neuronal surface where the bioelectric phenomena occur, and (*iii*) the parallelism between the enzyme activity and the voltage of the nerve action potential developed by the electric organ. In these experiments, it was assumed that the enzyme is specific, *i.e.*, that the substrate metabolized is acetylcholine, the release of which during nerve activity has been demonstrated at several instances.

Evidence has now been obtained that the enzyme present in various nerve tissues, on which the role of acetylcholine in the mechanism of nervous action has been studied, is a specific enzyme. It differs essentially from the esterases present in other tissues or serum in which, as shown by Stedman, Stedman, and Easson,[4] only a fraction is specific choline esterase. Whatever nervous tissue is used the enzyme present has the same typical properties. It is unable to split carbaminoylcholine and benzoylcholine. That the latter compound is not split by brain esterase was already observed previously.[5] It splits butyrylcholine at a much lower rate than acetylcholine. On the other hand, acetyl-β-methylcholine which is not hydrolyzed by most other tissues is split by nerve esterase, although at a rate 20 to 40 per cent. lower than acetylcholine. Table 1 gives a few examples of significant data chosen among a number of substrates and tissues tested. The results thus provide further essential support for the new concept of the role of acetylcholine in the mechanism of nervous action.

TABLE 1

RATE OF ESTERASE ACTIVITY OF DIFFERENT TISSUES COMPARED TO THAT OF ACETYLCHOLINE (= 100)

Species	Tissue	Benzoyl = Choline	Butyryl = Choline
Rat	Brain	0	20
Squid (Loligo paealii)	Ganglion	0	24
	Fiber	0	48
Lobster (Homarus vulgaris)	Ab. chain	0	15
Electric eel (Electrophorus electricus)	Electric organ	0	3
Torpedo	" "	0	0
Rabbit	Liver	31	130
Guinea-pig	Pancreas	65	200
" "	Kidney	200	350
Human	Serum	60	272

[4] E. Stedman, E. Stedman and L. H. Easson, *Biochem. Jour.*, 26: 2056, 1932.

[5] B. Mendel, D. B. Mundell and H. Rudney, *Biochem. Jour.*, 37: 473, 1943.

This concept has been criticized by Lorente de Nó[6] because he is unable to find an effect on the frog's sciatic when put into concentrated acetylcholine solution. It is extremely difficult to reproduce an *intracellular* process by adding a compound to a living cell in a test-tube (see insulin). The failure to produce such an effect is therefore meaningless and can not be considered as contrary to a concept based on an impressive body of biochemical and physiological evidence. Acetylcholine is a quaternary ammonium base. Such compounds usually do not permeate the living cell membrane. Eserine is a tertiary ammonium base which as a free base may enter the cell. With eserine, Lorente de Nó finds a depolarization of the nerve—a point quite consistent with the mechanism suggested.

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BRAIN-WEIGHT AND BODY-WEIGHT IN THE RED SPIDER MONKEY

IN recent compilations of the brain and body weights of primates[1,2] the Cebidae are represented as having the highest brain to body weight ratio of any of the primates including man. The coefficients of cephalization computed for them are correspondingly high.

The recorded data are chiefly those of Hrdlička,[3] and the body weights which he gives for Cebus and for Ateles are very much less than the weights of adult animals for those genera with which we are familiar. Table 1 gives the weights of 19 adult red

TABLE 1

WEIGHTS OF 10 ADULT RED SPIDER MONKEYS

Males	Females	
5.19 kg	4.27 kg	5.36 kg
6.63	4.82	5.39
6.89	4.85	5.42
	5.08	5.78
	5.13	5.81
	5.22	5.87
	5.22	5.96
	5.25	6.01

[6] R. Lorente de Nó, *Jour. Cell. Comp. Physiol.*, 24: 85, 1944.

[1] S. Zuckerman, "Functional Affinities of Man, Monkeys, and Apes." New York: Harcourt, Brace and Co., 1933.

[2] G. von Bonin, *Jour. Psychol.*, 16: 379–389, 1937.

[3] A. Hrdlička, *Amer. Jour. Phys. Anthrop.*, 8: 201–211, 1925.

spider monkeys (*Ateles geoffroyi*) at the Yerkes Laboratories. The average is 5.48 kg with a range from 4.27 kg to 6.89 kg. The average weight of the males is 6.24 kg; of the females 5.34 kg. These animals have been in captivity from 7 to 9 years and are sexually mature. They have had an adequate opportunity for exercise and do not have an excess of fat. The average of 5.48 kg is certainly more typical of the adult Ateles than the averages of 2.0 and 2.2 computed by Zuckerman and von Bonin from Hrdlička's data. It is apparent that this author was correct in stating that 4 of the animals he weighed were emaciated, but it is doubtful if any of them were adult.

The average of 10 brains of *Ateles geoffroyi*, fixed in formalin, is 91.6 with a range from 75.5 to 107 grams. Body weights and sex of these animals are not known, but most of them were used for acute experiments and were selected because of their small size. The brain weights, however, closely approach those given by Hrdlička, which average 95.6 grams, and the difference may well be due to the fixation. Computation of brain-body weight ratio from our figures gives a value of 16.7 instead of 44.9 reported by Zuckerman and a coefficient of cephalization of 0.33 instead of 0.62 computed by von Bonin.

Although we have not material at hand for measurement, we believe, from experience with adult animals, that the published figures for Cebus and some other members of the order may be as greatly in error as those for Ateles have proved to be. Certainly no attempt to correlate brain-body weight ratios with intelligence in the primates can be justified until more accurate anatomic data are available.

GEORGE CLARK

YERKES LABORATORIES OF PRIMATE BIOLOGY,
ORANGE PARK, FLORIDA

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ANTI-RETICULAR IMMUNE SERUM: ITS ACTION DEMONSTRATED BY TISSUE CULTURE TECHNIQUE[1]

A GROUP of Soviet investigators under the leadership of A. A. Bogomolets have recently emphasized the importance of anti-reticular cytotoxic serum (ACS) as a means of pathogenetic therapy.[2] It has been reported that such serum possesses stimulating effect on the reticulo-endothelial system (RES) when used in minute doses. When the same serum is employed at large doses the effect is "cytotoxic" for the RES.

To our knowledge no demonstration has been made as to the direct action of ACS on living cells *in vitro*. The following is a preliminary report on a phase of a group project dealing with this subject.

Since tissue culture technique affords a direct method of observing cellular responses this method is being utilized. The serum (ACS) was prepared by using spleen and rib marrow of guinea pigs as antigen for immunization of rabbits. Gradually increasing amounts of the tissues were given four times intravenously and orally at 4 to 5 day intervals. One hundred tissue cultures in hanging-drop were used for the first series of experiments. The medium consisted of fresh embryonic extract from chick embryos incubated seven days, combined with normal rabbit serum, the final dilution being 1:10 for control experiments. For test purposes the rabbit ACS was substituted. The clot was formed by combining these components with fresh heparinized rooster plasma. Four sets of tissues were cultivated: (1) adult guinea pig spleen in medium containing normal control rabbit serum; (2) adult guinea pig spleen in medium containing ACS; (3) spleen from 14-day chick in medium containing normal rabbit serum; (4) spleen from 14-day chick in medium containing ACS. After 48 hours cultivation at 37° C no difference in the abundant outgrowth was seen between controls and the ACS treated cultures of embryonic chick spleen.

In striking contrast adult guinea pig spleen cultures showed practically no outgrowth of cells in medium containing ACS, whereas such tissues in control cultures uniformly showed abundant migration of cellular elements.

These results indicate (1) the reality of the strong inhibitory action of ACS when a homologous cell system is used, (2) that this action is specific for guinea pig as compared with chick spleen cultivated under identical conditions. These observations demonstrate only the inhibitory phase of the potentialities of ACS, while its stimulating property on the RES will be determined by serial dilutions of this serum. We believe it will be possible to define by the behavior of cells *in vitro* the action of ACS from total inhibition to marked stimulation; the two extremes of ACS action which are apparently of practical significance.

Studies in progress will also establish cytological changes as well as serological and immunological phenomena involved.

CHARLES M. POMERAT
LUDWIK ANIGSTEIN

[1] From the Departments of Anatomy and Preventive Medicine and Public Health, University of Texas, Medical Branch, Galveston, Texas.

[2] A. A. Bogomolets, *Amer. Rev. Soviet Medicine*, I, 101–112, 1943; P. D. Marchuk, *ibid.*, p. 113–123; B. E. Linberg, *ibid.*, p. 124–129.

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SCIENCE NEWS

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THE RADIO SPECTRUM

IT is not likely that the Federal Communications Commission will be able to issue its decision on the allocation of radio frequencies for television, FM, facsimile, standard broadcast, educational needs, police and fire and other services before January or February. It will be physically impossible for the commissioners to review over 5,000 pages of testimony presented during five weeks of hearings which ended in Washington on November 2, and present their complete decisions within less than eight or ten weeks.

Decisions on the allocation of parts of the wavelength spectrum will not be held up until the complete report is ready, since the State Department is anxious to have the spectrum apportioned at the earliest possible moment, so that the position of the United States in regard to frequency allocation will be on the record before the Pan-American radio conference scheduled to be held next year in Rio de Janeiro takes place.

Speculation among those familiar with the testimony and with the views of the FCC commissioners seems to be pretty well crystallized. It is obvious that there is just not enough space in the radio spectrum to take care of all the requests that have been made.

On the big question of television frequency allocations, the FCC may be expected to compromise between the two groups who are conflicting over the future of television. Some want to go ahead with television in its present stage of development, believing that the present-day images on the television screen, as well as present programming, will find favor with the public. Others desire to experiment and perfect television and operate in the upper frequencies.

Frequency modulation may be able to let out its belt since it will get almost double the portion of the spectrum it now has. Facsimile, the system of sending pictures and even complete newspapers through the air to be printed in home or office, will probably be assigned to operate high up in the spectrum or dove-tailed in with other services by multiplexing. Educational broadcasters will get pretty much what they asked for at the hearings, including the possibility of short wave for international educational broadcasting. Police and fire departments will also receive enough space to conduct their operations, with the exception of television broadcasting, on which they may be limited.—ROBERT N. FARR.

ITEMS

THE Giantess geyser, in the Old Faithful area of Yellowstone National Park, recently erupted for the first time since June, 1942. Noises during the night, resembling subterranean cannonading, were recognized by District Park Ranger Bauman as symptoms of one of the Giantess' tantrums. In the morning the geyser was found steaming heavily, with little water in its crater, but showing signs of having overflowed during the night, the water damaging the rim somewhat and washing away most of the minute plants called algae which give geyser craters and hot springs formations their coloring. On the west side of the crater the deposit known as sinter had been washed away and spread out in fragments or layers like an alluvial fan. Shortly the geyser again erupted, shooting up rockets of water to a height of from 80 to 100 feet; and geysering continued at about 20-minute intervals until well into the afternoon. Shortly after noon jets of water reached a height of at least 150 feet. The Giantess is one of the most powerful of the park's geysers, its eruptions lasting from 12 to 36 hours. Once it erupted every 10 or 20 days, but now eruptions occur at much longer intervals. Again asleep, it is difficult to foretell when the Giantess will next go into action.

A TOTAL of thirty-three scientific institutions were functioning in the city of Kharkov on the first anniversary of its liberation. Odessa ran a close second in restoration work, according to a report from the Soviet Scientists Anti-Fascist Committee. Work has been renewed in many Ukranian scientific research institutes, new quarters having been assigned to a number of them by the government. Liberation of Soviet cities is followed by intense activity, scientific workers putting forth every effort to restore their buildings, to put laboratory apparatus into condition and to replenish libraries.

POST-WAR airline promises were demonstrated recently when a group of Icelandic businessmen made a two-thousand mile trip that would take 14 days by boat in only 14 hours, breakfasting at Reykjavik, Iceland, having luncheon in Canada, and dining the same evening in New York City. Flown to the United States to attend the International Business Conference at Rye, N. Y., by the Air Transport Command, the men covered a distance almost equal to that between New York and Los Angeles. Higher-speed planes now being developed in American aircraft plants will be able to complete the same trip after the war in less than ten hours.

AN odorless, nonirritating household fly spray for post-war use in homes and restaurants has been developed by W. F. Barthel, H. L. Haller and F. B. LaForge, chemists of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. Used in the aerosol "bomb" developed by the Department of Agriculture for use by the armed forces against mosquitoes, the new fly spray promises to be an effective post-war weapon against flies, roaches, bedbugs, ants, mosquitoes, house spiders, silverfish, chiggers, carpet beetle larvae, dog ticks and dog fleas. It will be suitable for use in homes, restaurants, airplanes and any place where people congregate. The spray is made from the powerful insect-killer, pyrethrum, purified by a new method to eliminate the odor and the irritating impurities of the past.

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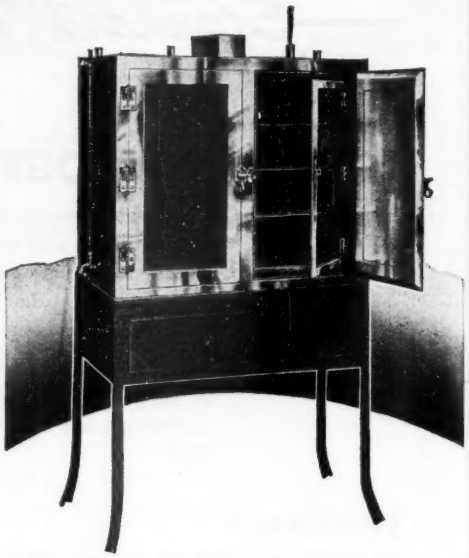

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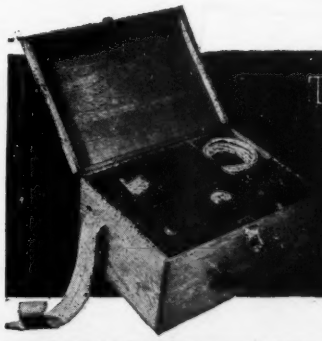

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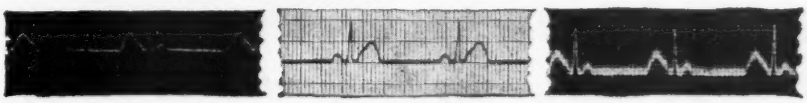
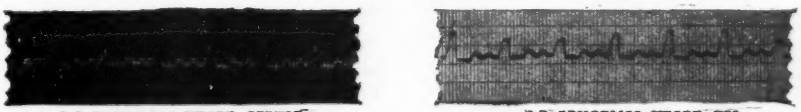


2-A CATHODE RAY 2-B EPL 2-C STRING

This characteristic is additionally demonstrated in the reproduction above which shows the record made by an artificial heart device made by three methods. It may be noted that the shape of the "T" wave is slightly slurred in the case of the string, and that the EPL graph is precisely identical to the cathode ray record.



3-A ABNORMAL HEART, STRING 3-B ABNORMAL HEART, EPL

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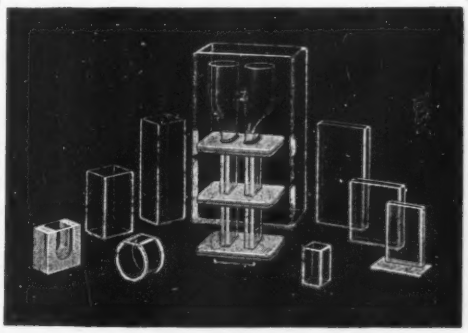

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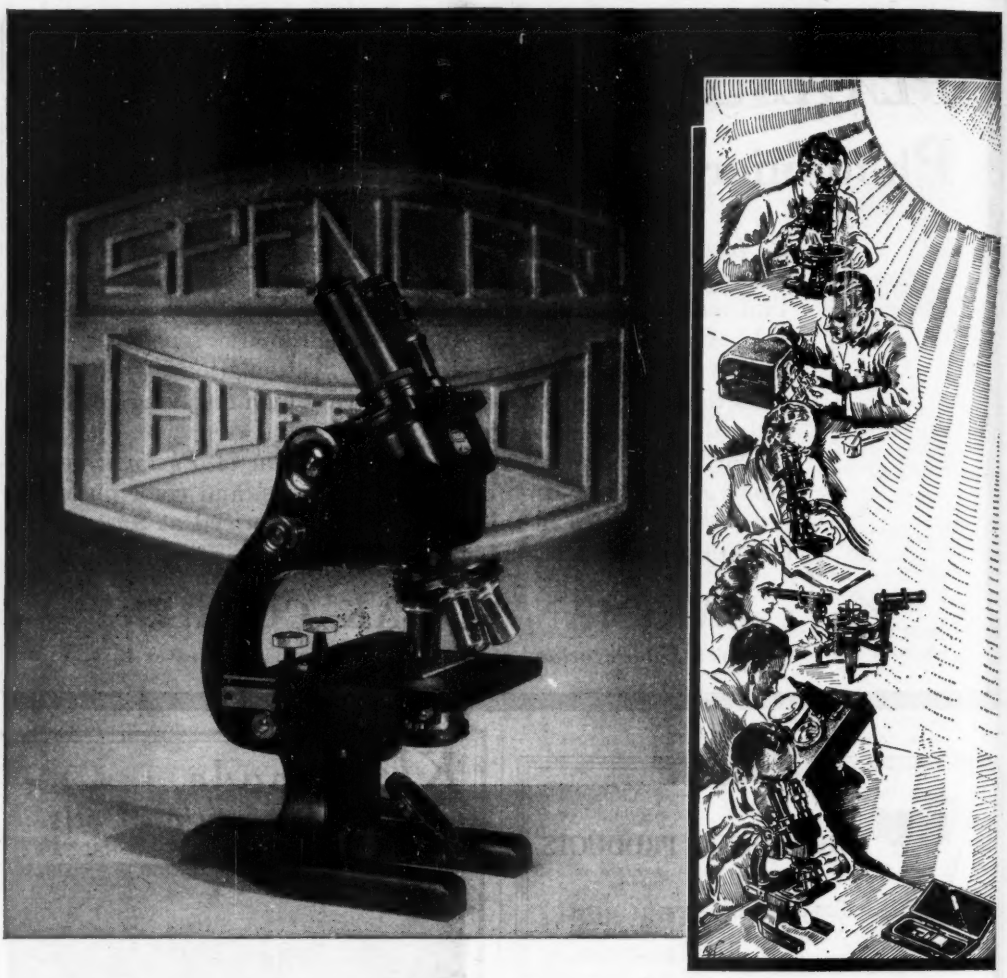

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